

WHAT IS CLAIMED IS:

1. A three-dimensional optical memory medium comprising:  
a solid medium forming a base substrate of said optical  
memory, said solid medium comprising luminescent ions having a  
5 first valence; and  
a plurality of spots which are three-dimensionally  
distributed in said solid medium, said luminescent ions being  
contained in said spots and having a second valence different from  
said first valence as a result of condensing a pulsed laser beam in  
10 said solid medium.
2. A three-dimensional optical memory medium according to  
claim 1, wherein said spots are different from said solid medium in  
emission wavelength and/or luminous intensity.
- 15 3. A three-dimensional optical memory medium according to  
claim 1, wherein said luminescent ions contained in said solid  
medium and said spots are rare earth element ions.
- 20 4. A three-dimensional optical memory medium according to  
claim 1, wherein said spots are prepared by condensing the pulsed  
laser beam in said solid medium to reduce said luminescent ions of  
said solid medium from said first valence to said second valence.
- 25 5. A three-dimensional optical memory medium according to  
claim 1, wherein said solid medium is made of an inorganic glass  
comprising aluminum.
- 30 6. A three-dimensional optical memory medium according to  
claim 3, wherein said rare earth element ions are ions of at least  
one rare earth element selected from the group consisting of Ce, Pr,  
Sm, Eu, Tb, Tm and Yb.

7. A three-dimensional optical memory medium according to claim 1, wherein said solid medium is made of a fluoride glass comprising (a) aluminum fluoride and (b) said luminescent ions that are trivalent Sm ions, and wherein said luminescent ions  
5 contained in said spots are bivalent Sm ions.
8. A three-dimensional optical memory medium according to claim 1, wherein said pulsed laser beam has a wavelength that is different from an absorption wavelength of said solid medium.  
10
9. A three-dimensional optical memory medium according to claim 1, wherein said pulsed laser beam has a peak power density of  $10^8$ - $10^{17}$  W/cm<sup>2</sup>.
10. A three-dimensional optical memory medium according to claim 1, wherein said pulsed laser beam has a pulse width not greater than  $10^{-10}$  seconds.  
15
11. A process for producing a three-dimensional optical memory medium, said process comprising:  
20 (a) providing a solid medium comprising luminescent ions having a first valence;  
(b) condensing a pulsed laser beam to a focal point in said solid medium such that a spot corresponding to said focal point is  
25 formed in said solid medium, said spot comprising said luminescent ions having a second valence different from said first valence; and  
(c) three-dimensionally scanning said solid medium with said pulsed laser beam such that a plural number of said spot are  
30 formed three-dimensionally in said solid medium, thereby producing said three-dimensional optical memory medium.
12. A process according to claim 11, wherein said luminescent

ions contained in said solid medium and said spots are rare earth element ions.

13. A process according to Claim 11, wherein said spots are  
5 prepared by condensing the pulsed laser beam in said solid medium to reduce said luminescent ions of said solid medium from said first valence to said second valence.

14. A process according to Claim 11, wherein said solid  
10 medium is made of an inorganic glass comprising aluminum.

15. A process according to claim 12, wherein said rare earth element ions are ions of at least one rare earth element selected from the group consisting of Ce, Pr, Sm, Eu, Tb, Tm and Yb.

16. A process according to Claim 11, wherein said solid medium is made of a fluoride glass comprising (a) aluminum fluoride and (b) said luminescent ions that are trivalent Sm ions, and wherein said luminescent ions contained in said spots are  
20 bivalent Sm ions.

17. A process according to Claim 11, wherein said pulsed laser beam has a wavelength that is different from an absorption wavelength of said solid medium.

18. A process according to Claim 11, wherein said pulsed laser beam has a peak power density of  $10^8$ - $10^{17}$  W/cm<sup>2</sup>.

19. A process according to Claim 11, wherein said pulsed laser  
30 beam has a pulse width not greater than  $10^{-10}$  seconds.

20. A process for reading information from a three-dimensional optical memory medium, said medium

comprising:

a solid medium forming a base substrate of said optical memory, said solid medium comprising luminescent ions having a first valence; and

- 5 a plurality of spots which are three-dimensionally distributed in said solid medium, said luminescent ions being contained in said spots and having a second valence different from said first valence as a result of condensing a pulsed laser beam in said solid medium, said process comprising:

- 10 irradiating said three-dimensional optical memory medium with a laser beam having a wavelength such that said luminescent ions contained in said spots are selectively excited and thereby emit light.